

AMENDMENTS TO THE CLAIMS

1. (Canceled)

2. (Currently Amended) A lead frame made of a thin metal plate,
comprising:
at least two stages;
a frame having a plurality of leads, which is arranged so as to encompass
the stages; and
a plurality of interconnecting members having elastically deforming
abilities, which are integrally combined together with the frame and are arranged so as
to interconnect together the stages and the frame;
~~according to claim 1,~~ wherein the plurality of interconnecting members
contain a plurality of corner leads for supporting the stages and a central lead having a
specific structure that is arranged between the stages so as to mutually interconnect
together the stages.

3. (Canceled)

4. (Currently Amended) A lead frame made of a thin metal plate,
comprising:
at least two stages;
a frame having a plurality of leads, which is arranged so as to encompass
the stages; and
a plurality of interconnecting members having elastically deforming
abilities, which are integrally combined together with the frame and are arranged so as
to interconnect together the stages and the frame;
further comprising a plurality of first projecting portions that are projected
from the stages towards the frame, and a plurality of second projecting portions that are
projected from the leads towards the stages, wherein each of the first projecting

portions is engaged with each of the second projecting portions in a thickness direction of the thin metal plate;

~~according to claim 1,~~ wherein the interconnecting members include easy-to-deform portions that can be elastically deformed when pressed, and bent portions that can be bent by plastic deformation.

5. (Currently Amended) A lead frame made of a thin metal plate,
comprising:

at least two stages;

a frame having a plurality of leads, which is arranged so as to encompass the stages; and

a plurality of interconnecting members having elastically deforming abilities, which are integrally combined together with the frame and are arranged so as to interconnect together the stages and the frame;

~~according to claim 1,~~ wherein easy-to-deform portions that can be elastically deformed when pressed are formed in the interconnecting members, and wherein pressing members that are projected from the leads towards the stages are formed so as to press the stages in a thickness direction of the thin metal plate.

6. (Original) A lead frame according to claim 4, wherein the first projecting portion has a projection and the second projecting portion has a hollow portion, so that the first and second projecting portions partially overlap each other when the projection is engaged with the hollow portion.

7. (Original) A lead frame according to claim 2, wherein easy-to-deform portions that can be elastically deformed when pressed are formed in the corner leads, and bent portions that can be bent by plastic deformation are formed at ends of the corner leads in proximity to the stages and are formed at selected positions of the central lead in proximity to the stages.

8. (Original) A lead frame according to claim 7, further comprising a plurality of projecting portions that are projected from the stages towards the frame and that are engaged with specifically designed leads, which are projected from the frame towards the stages.

9. (Original) A lead frame according to claim 7, wherein projections are formed at selected positions of the central lead arranged between the stages.

10. (Original) A manufacturing method of a magnetic sensor encapsulating at least one magnetic sensor chip having sensitivity to magnetism in at least one direction in a molded resin, comprising the steps of:

providing a lead frame made of a thin metal plate, which comprises at least two stages, a frame having a plurality of leads arranged so as to encompass the stages, and a plurality of interconnecting members for interconnecting together the frame and the stages;

inclining the stages relative to the frame upon plastic deformation of the interconnecting members;

pressing the stages under pressure while fixing the frame in a prescribed position, thus elastically deforming the interconnecting members;

bonding the magnetic sensor chip onto the stage while the stage and the frame are both placed substantially in a same plane;

arranging wires so as to interconnect together the leads and the magnetic sensor chip; and

releasing the stages from the pressure, thus restoring the interconnecting members from elastically deformed states thereof.

11. (Original) The manufacturing method of a magnetic sensor according to claim 10, wherein the interconnecting members are subjected to plastic deformation at bent portions, which are arranged in proximity to the stages, and wherein the

interconnecting members are elastically bent at easy-to-deform portions that are formed at selected positions of the interconnecting members for supporting the stages.

12. (Original) The manufacturing method of a magnetic sensor according to claim 10, wherein a plurality of first projecting portions are projected from the stages towards the leads while a plurality of second projecting portions are projected from the frame toward the stages, said manufacturing method further comprising the step of:
after restoring the interconnecting members from the elastically deformed states thereof, the first projecting portions are partially overlapped with the second projecting portions in a thickness direction of the thin metal plate.

13. (Original) The manufacturing method of a magnetic sensor according to claim 12, wherein the first projecting portion has a projection while the second projecting portion has a hollow portion, so that the projection and the hollow portion are engaged with each other when the first projecting portion is partially overlapped with the second projecting portion.

14. (Original) A manufacturing method of a magnetic sensor encapsulating at least one magnetic sensor chip sensitive to magnetism in at least one direction in a molded resin, comprising the steps of:

preparing a lead frame made of a thin metal plate, which comprises at least two stages, a frame having a plurality of leads encompassing the stages, a plurality of interconnecting members for interconnecting the stages with the frame, and a plurality of pressing members projected from the leads towards the stages;

bonding a magnetic sensor chip onto each of the stages, which are placed substantially in a same plane of the frame;

wiring the magnetic sensor chip together with the leads; and

subjecting the interconnecting members to elastic deformation while the stages and the pressing members are overlapped in positions in a thickness direction of

the thin metal plate, so that the stages are respectively inclined at prescribed angles against the frame.

15. (Original) A lead frame made of a thin metal plate, comprising:
at least two stages;
a frame having a plurality of leads encompassing the stages;
a plurality of interconnecting members for interconnecting the stages with the frame, wherein the interconnecting member has a distorted portion that is subjected to plastic deformation and/or elastic deformation; and
a plurality of projecting elements that are projected upwardly or downwardly from the stages respectively.

16. (Original) A lead frame according to claim 15, wherein each of the stages is interconnected with a pair of projecting elements that are elongated from the interconnecting members via the distorted portions.

17. (Original) A manufacturing method of a magnetic sensor, comprising the steps of:

preparing a lead frame made of a thin metal plate, which comprises at least two stages, a frame having a plurality of leads, a plurality of interconnecting members for interconnecting the stages with the frame, and a plurality of projecting elements that are projected upwardly or downwardly from the stages respectively;

bonding a magnetic sensor chip sensitive to magnetism in at least one direction therefrom onto each of the stages;

wiring the leads with the magnetic sensor chip mounted on the stage;

fixing the lead frame into a metal mold;

pressing the projecting elements by the metal mold so as to incline the stages against the frame and to partially deform the interconnecting members; and

injecting a resin material into the metal mold so as to encapsulate the magnetic sensor chip mounted on the stage of the lead frame in a resin.

18. (Original) The manufacturing method of a magnetic sensor according to claim 17, wherein the interconnecting members have distorted portions by which the projecting elements are arranged for the stages respectively, so that when the projecting elements are pressed by the metal mold that is closed, the stages are inclined while the interconnecting members are partially deformed at the distorted portions.

19. (Original) A lead frame made of a thin metal plate, comprising:
at least two stages;
a frame having a plurality of leads arranged so as to encompass the stages; and
a plurality of interconnecting members for interconnecting the stages with the frame, wherein the interconnecting members have bent portions that are arranged in proximity to the stages respectively and that can be bent upon plastic deformation and/or elastic deformation.

20. (Original) A lead frame made of a thin metal plate, comprising:
at least two stages;
a frame having a plurality of leads arranged so as to encompass the stages;
a plurality of interconnecting members for interconnecting the stages with the frame; and
at least one stage interconnecting member for mutually interconnecting the stages together, wherein the stage interconnecting member is shaped so as to allow plastic deformation.

21. (Original) A lead frame according to claim 20, wherein the stage interconnecting member has a zigzag shape by which the stages are interconnected together.

22. (Original) A lead frame according to claim 20, wherein a pair of stage interconnecting members each having reduced dimensions are arranged so as to interconnect together both side ends of the stages.

23. (Original) A manufacturing method of a magnetic sensor equipped with at least one magnetic sensor chip sensitive to components of magnetism in a prescribed direction, comprising the steps of:

preparing a lead frame made of a thin metal plate, which comprises at least two stages, a frame having a plurality of leads encompassing the stages, and a plurality of interconnecting members for interconnecting the stages with the frame;

bonding the magnetic sensor chip onto each of the stages;

wiring the magnetic sensor chip with the leads; and

subjecting the interconnecting members to plastic deformation so as to incline the stages at prescribed angles against the frame.

24. (Original) The manufacturing method of a magnetic sensor according to claim 23, wherein the lead frame further comprises at least one stage interconnecting member for mutually interconnecting the stages together, and wherein the stage interconnecting member is subjected to plastic deformation when the stages are inclined.

25. (Original) A manufacturing method of a magnetic sensor equipped with at least one magnetic sensor chip sensitive to components of magnetism in a prescribed direction, comprising the steps of:

preparing a lead frame made of a thin metal plate, which comprises at least two stages, a frame having a plurality of leads encompassing the stages, and a plurality of interconnecting members for interconnecting the stages with the frame;

bonding the magnetic sensor chip onto each of the stages;

wiring the magnetic sensor chip with the leads; and

subjecting the interconnecting members and prescribed parts of the stages to plastic deformation so as to incline the stages at prescribed angles against the frame.

26. (Original) A manufacturing method of a magnetic sensor equipped with at least one magnetic sensor chip sensitive to components of magnetism in a prescribed direction, comprising the steps of:

preparing a lead frame made of a thin metal plate, which comprises at least two stages, a frame having a plurality of leads encompassing the stages, a plurality of interconnecting members for interconnecting the stages with the frame, and at least one stage interconnecting member for mutually interconnecting the stages together;

bonding the magnetic sensor chip onto each of the stages;

wiring the magnetic sensor chip with the leads; and

subjecting the stage interconnecting member to plastic deformation so as to incline the stages at prescribed angles against the frame.

27. (Original) A magnetic sensor comprising:

a first magnetic sensor chip sensitive to components of magnetism in two sensing directions respectively; and

a second magnetic sensor chip sensitive to components of magnetism in a single sensing direction, which crosses at an acute angle to a plane defined by the two sensing directions of the first magnetic sensor chip.

28. (Original) A magnetic sensor comprising:

a first magnetic sensor chip sensitive to components of magnetism in a first sensing direction;

a second magnetic sensor chip sensitive to components of magnetism in a second sensing direction that crosses the first sensing direction; and

a third magnetic sensor chip sensitive to components of magnetism in a third sensing direction that crosses a plane defined by the first and second sensing directions.

29. (Original) A magnetic sensor comprising:
a first magnetic sensor chip sensitive to components of magnetism in two sensing directions defining a first plane; and
a second magnetic sensor chip sensitive to components of magnetism in two sensing directions defining a second plane,
wherein the first plane crosses the second plane.

30. (Original) A magnetic sensor according to any one of claims 27 to 29, wherein the magnetic sensor chips are arranged inside of a same package in such a way that the sensing directions are respectively inclined against a bottom of the package.

31. (Canceled)

32. (Original) A manufacturing method of a magnetic sensor having at least one magnetic sensor chip sensitive to components of magnetism in a single direction, comprising the steps of:

preparing a lead frame made of a thin metal plate, which comprises at least two stages, a frame having a plurality of leads arranged so as to encompass the stages, and a plurality of interconnecting members for interconnecting the stages with the frame;

bonding a magnetic sensor chip onto each of the stages;

wiring the magnetic sensor chip with the leads;

inclining the stages using pins in a metal mold so as to partially deform the interconnecting members; and

injecting a melted resin into the metal mold, thus molding the lead frame and the magnetic sensor chips in a resin.

33. (Original) The manufacturing method of a magnetic sensor according to claim 32, wherein the interconnecting members have distorted portions that are distorted upon plastic deformation and/or elastic deformation when the stages are inclined under pressure applied thereto by the pins in the metal mold.

34. (Original) The manufacturing method of a magnetic sensor according to claim 32 or 33, wherein each of the pins is retractably inserted into the metal mold so as to press each of the stages.

35. (Original) A sensor device comprising:
a pair of magnetic sensor chips, which are respectively inclined with an acute angle therebetween and which are horizontally arranged on a board.

36. (Original) A sensor device comprising:
a pair of magnetic sensor chips, which are respectively inclined with an acute angle therebetween and which are arranged vertically with respect to a board.